

Unit 1.1

The changing face of the earth

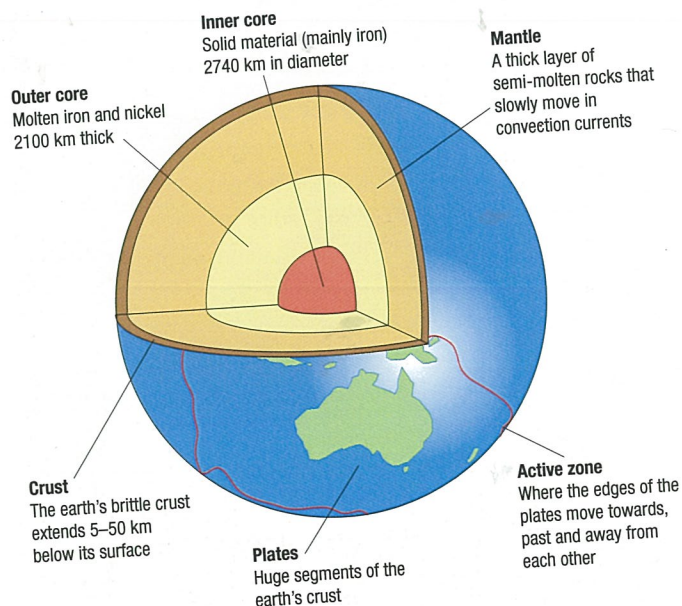
Forces deep within the earth cause the movement of tectonic plates, which in turn create new landforms. Without these new landforms, the earth's surface would have long ago been reduced to a flat, featureless plain—worn down by the processes of weathering and erosion.

Plate tectonics

The earth's thin **crust** is broken into eight vast segments or **plates** (and several smaller plates) that travel slowly across the face of the planet at a rate of about 15 centimetres per year. This movement is caused by currents deep within the earth's liquid **mantle** (shown in Figure 1.1). This process is known as **plate tectonics**, or continental drift.

Continents on the move

Scientists believe that all the earth's continents were once part of one large supercontinent, known as Pangaea (a Greek word meaning 'all lands'). Pangaea consisted of two main areas: Gondwanaland (Australia, Antarctica, Africa, India and South America) and Laurasia (Asia, Europe, Greenland and North America). These two main areas began to move apart and break up about 200 million years ago. Over time they 'drifted' to their present locations.



Types of plate movements

Each of the earth's plates moves in a different way, as:

- a convergent plate boundary (towards each other)
- a divergent plate boundary (away from each other) or
- a transform plate boundary (past each other).

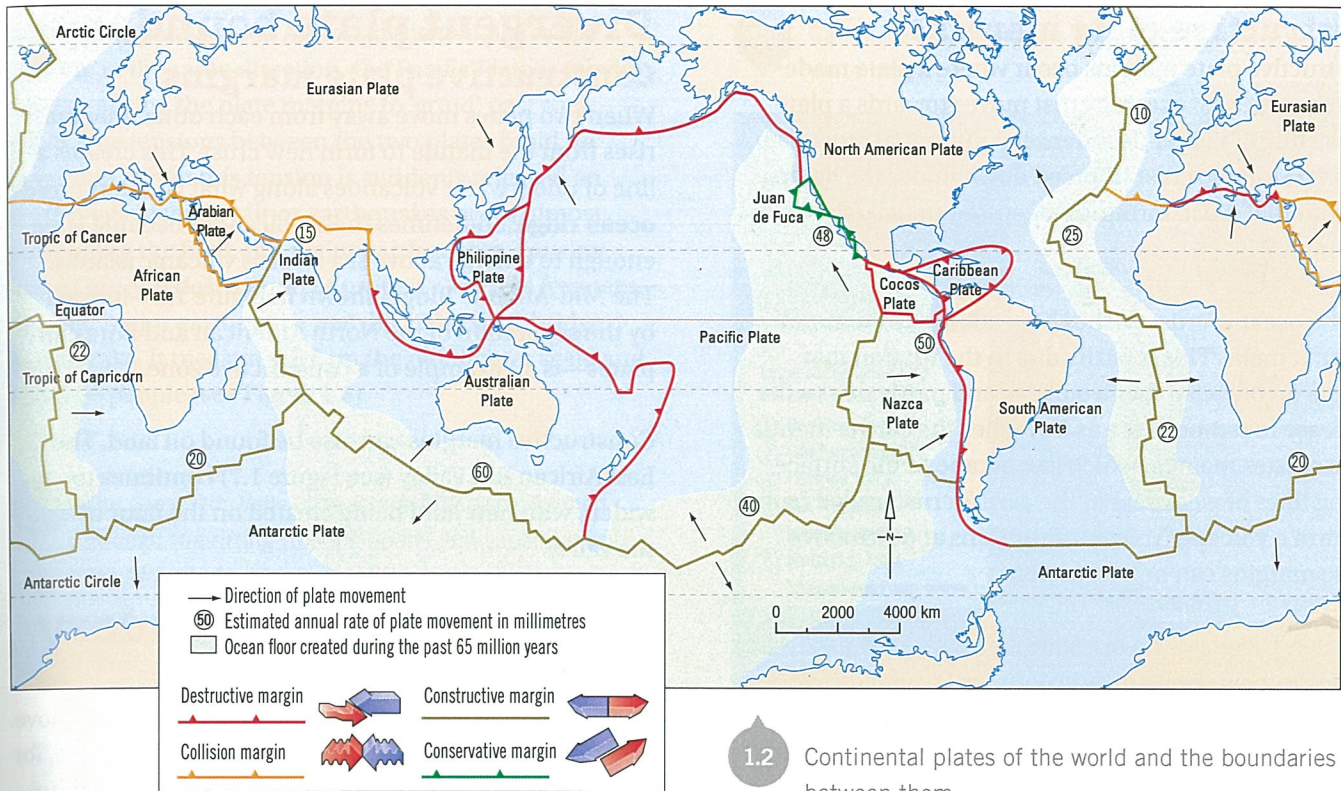
The places where the plates meet are known as **plate margins**. These are often areas of great stress and activity. Many of the earth's earthquakes, volcanoes and **fold mountains** are located at the plate margins. Figure 1.2 shows the location of the earth's plates and the directions in which they are moving.

Convergent plate boundary Collision plate margins

When two plates made of continental crust move towards one another they create a collision zone, as shown in Figure 1.3. Because neither plate can sink beneath the other, their crusts crumple upwards to form fold mountains. The Himalaya (see Figure 1.4), formed as a result of the collision between the Indian and Eurasian plates, is an example of a fold mountain system. Sometimes pressure builds up over time. Eventually the crust breaks, sending out shockwaves in the form of an earthquake.

DID YOU KNOW?

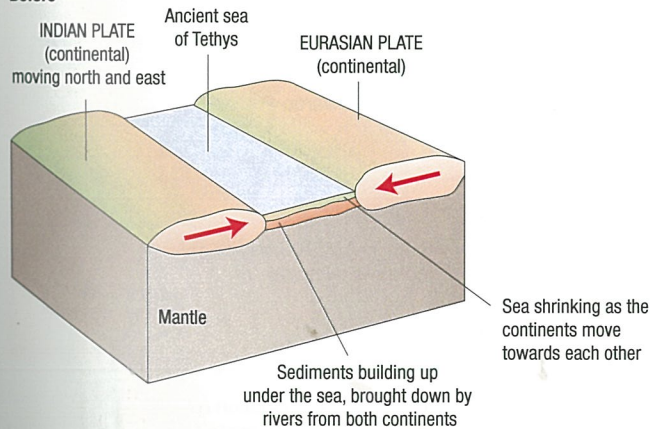
At 8880 metres above sea level, Mt Everest is the highest point on the earth's surface. It is not, however, the world's highest mountain. From base to peak, Mauna Kea on Hawaii measures 10 023 metres, 5818 metres of which is below the Pacific Ocean.



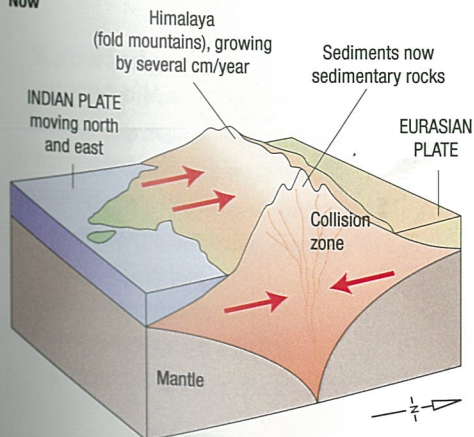
1.2 Continental plates of the world and the boundaries between them

1.3 A collision plate margin

Before



Now



1.4 The Himalayan Mountains are still increasing in height as the Indian Plate moves into the Eurasian Plate at a rate of about 5 centimetres a year.



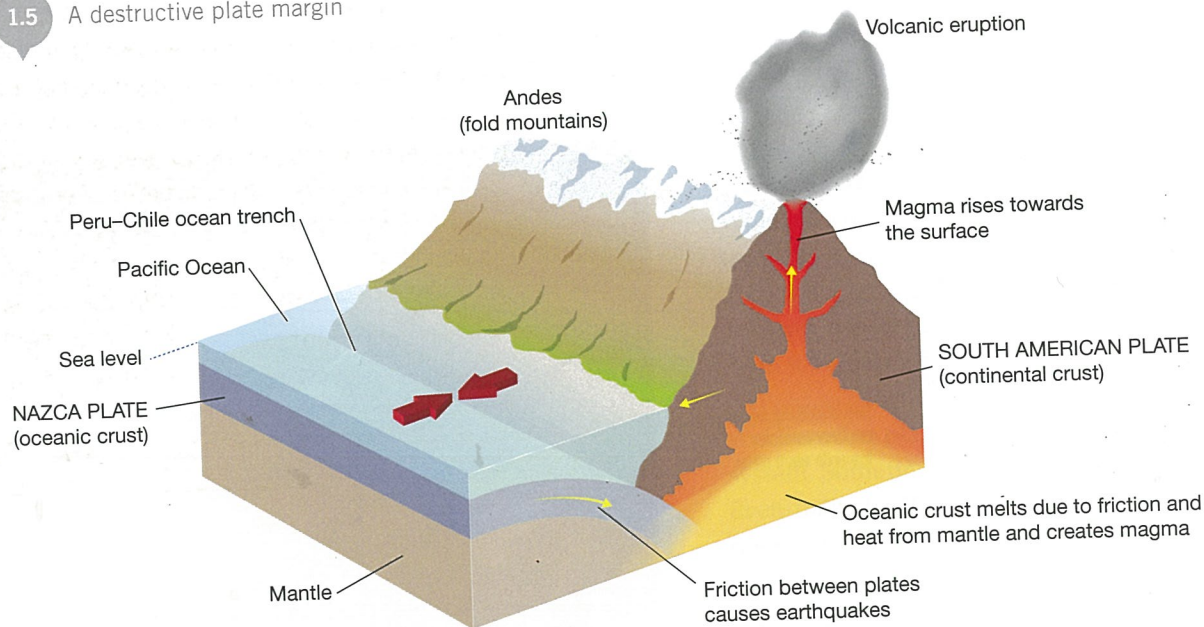
Destructive plate margins

Destructive plate margins occur where a plate made of heavy (dense) oceanic crust moves towards a plate consisting of lighter (less dense) continental crust. The heavier oceanic crust is forced down under the lighter continental crust, forming a deep-sea trench (shown in Figure 1.5).

As the oceanic crust pushes beneath the continental crust, it melts. This is partly due to the friction that builds up between the two plates and partly due to the increase in temperature as it reaches the earth's mantle. This creates magma, which can escape to the surface along lines of weakness in the earth's crust, called faults, to form a **volcano**. Volcanic eruptions at destructive plate margins can be very violent.

Because the plates do not slide smoothly past each other, there is often an enormous build-up of pressure. If the crust breaks, shock waves are sent out in all directions, causing an **earthquake**.

1.5 A destructive plate margin



Divergent plate boundary

Constructive plate margins

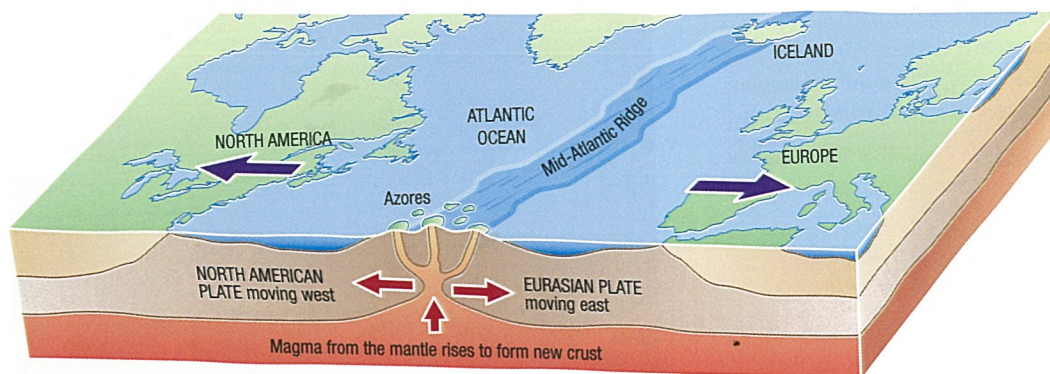
When two plates move away from each other, magma rises from the mantle to form new crust. This creates a line of underwater volcanoes along what is called a **mid-ocean ridge**. Sometimes these volcanoes become large enough to emerge above sea level as volcanic islands. The Mid-Atlantic Ridge, shown in Figure 1.6—formed by the separation of the North American and Eurasian plates—is an example of a constructive zone.

Constructive margins can also be found on land. The East African Rift Valley (see Figure 1.7) continues to widen, with new land being created on the floor of the valley.

Transform plate boundary

Conservative plate margins

Conservative plate margins occur where two plates move past one another. The San Andreas Fault in California, for example, marks the point at which the North American



1.6 The Mid-Atlantic Ridge was formed by the separation of the North American and Eurasian plates. Each year the Atlantic Ocean widens by about 3 centimetres.

1.7 The Great Rift Valley in eastern Africa was formed through the rifting (tearing apart) and separation of the African, Arabian and Indian tectonic plates.



- 1 State the name given to the processes involved in the movement of the earth's crust. Explain the causes of this movement.
- 2 Name the types of plate margins.
- 3 Describe what happens to the earth's crust in a collision zone.

4 Study Figure 1.2.

The top portion of the image is a map of California and the surrounding regions. The Pacific Ocean is to the west, and Mexico is to the south. The San Andreas Fault is shown as a thick purple line running from the San Francisco Bay area in the north to the Mexican border in the south. Five locations are marked with numbered circles along the fault: 1 (San Francisco 1906), 2 (San Fernando 1971), 3 (Coalinga 1983), 4 (San Francisco/Loma Prieta 1989), and 5 (Northridge 1994). A key box on the left lists these earthquakes. A scale bar indicates 0 to 300 km. A north arrow is in the top left. A red dashed line separates the Pacific Plate (moving north-west by 6 cm per year) from the North American Plate (moving north-west by 1 cm per year). An inset map shows the location of California within the United States.

The bottom portion of the image is a photograph of the San Andreas Fault in a desert landscape. The fault is a deep, straight crack in the dry, brownish ground, with steep, eroded hills on either side. The landscape is arid and hilly, with some sparse vegetation.